

## Upper Carboniferous (Late Pennsylvanian) microfossils from the Wandel Sea Basin, Peary Land, eastern North Greenland

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The following account identifies and discusses the microfauna and microflora from samples of Upper Carboniferous limestone collected from Hellefiskefjord in eastern Peary Land (fig. 4) by J. C. Troelsen during 1949 when a member of the Danish Peary Land Expedition (1947–1950). The samples were obtained from a section of limestones and shales which, as far as currently known, comprises the basal unit in the Hellefiskefjord area of the Wandel Sea Sedimentary Basin (Peel *et al.*, 1974). The age of the samples is considered to be Late Pennsylvanian (Late Virgilian?), confirming the suggestion made by Troelsen (1950) on the basis of the occurrence of *Triticites*.

The name Wandel Sea Basin was proposed by Dawes & Soper (1973) for an extensive series of Carboniferous to Tertiary sediments preserved as outliers in eastern North Greenland. The deposits overlie folded and eroded mainly Lower Palaeozoic strata of the North Greenland and East Greenland fold belts with major unconformity and provide an upper age limit for the main phases of orogenic activity in these geosynclines.

In the Amdrup Land–Holm Land area, some 300 km to the south-east, the oldest known strata in the Wandel Sea Basin are Lower Carboniferous clastics somewhat older than the late Upper Carboniferous calcareous sequence at Hellefiskefjord (see summary *in* Dawes, 1976). However, the lateral extension of units in the Peary Land part of the basin is so poorly known that it is currently difficult to evaluate the stratigraphic or structural significance of this difference.

A summary of the Wandel Sea Basin sequence in eastern Peary Land is given by Peel *et al.* (1974). The Carboniferous–Permian section at Hellefiskefjord is divided into a lower unit of at least 80 m of fusulinid limestone, violet shales and shaly limestone, and an upper unit of at least 230 m of brown-weathering grey, thin-bedded limestone. The Late Pennsylvanian microfauna and microflora discussed here were obtained from the lower unit. The upper unit contains a rich fauna of brachiopods and other fossils indicating a Lower Permian age (Stehli *in* Dawes, 1976).

### *Identifications and stratigraphic locations*

The basal unit in the section measured by Troelsen in Hellefiskefjord is a basic sill intruded into folded Silurian sediments (section height 0–c. 10 m). Samples in the overlying Carboniferous are referred to a datum in a thin violet shale about 25 cm in thickness at a section height of c. 12 m.

## Sample 171

75–100 cm under the violet shale, section height c. 11 m.

## Larger and smaller foraminiferids

*Triticites* sp. A.  
 indet, fusulinid (cf. *Pseudofusulinella*)  
 bradyinid or globivalvulinid  
 cf. *Climacammina* sp.  
*Syzrania* sp.  
*Tuberitina bulbacea* Galloway & Harlton, 1928

## Algae

indet. encrusting algae

## Other skeletal fragments

echinoderm  
 fenestellid bryozoan  
 punctate brachiopod  
 indet. ostracode  
 sponge spicule

## Sample 182

35 cm under the violet shale, section height c. 11.65 m.

## Larger and smaller foraminiferids

*Triticites* sp. B  
*Pseudofusulinella* sp.  
*Globivalvulina* sp.  
*Bradyina* sp.  
*Tetrataxis* group *T. conica* Ehrenberg, 1843  
*Climacammina* sp.

*Syzrania* sp.*Millerella* sp.*Eotuberitina* sp.

## Other skeletal fragments

bryozoan  
 ostracode

## Sample 175

Calcareous lens in the violet shale, section height 12 m.

## Larger and smaller foraminiferids

*Triticites* sp. C.  
 indet. fusulinid  
*Globivalvulina* sp.  
*Tetrataxis* group *T. conica* Ehrenberg, 1843  
 cf. *Climacammina* sp.  
*Millerella* sp.  
*Tuberitina bulbacea* Galloway & Harlton, 1928

## Algae

*Spaeroporella* sp.  
 cf. *Cuneiphycus* and *Stacheia* sp.  
 indet. algae  
*Osagia* sp. (algal-foraminiferid colony)  
 cf. *Tubiphytes*

## Other skeletal fragments

echinoderm  
 fenestellid bryozoan  
*Tentaculites* ? sp.

## Sample 172

10 cm above the violet shale, section height c. 12.2 m.

## Larger and smaller foraminiferids

*Triticites* sp. A ?

indet. fusulinid

*Globivalvulina* group *G. bulboides* (Brady)  
1876

*Tetrataxis* group *T. conica* Ehrenberg, 1843

indet. tetrataxid

cf. *Millerella* sp.

*Syzrania bella* Reitinger, 1950

*Brunsia* sp.

*Glomospira* sp.

? cornuspirid sp. = (*Apterrinella* ? sp. in Toomey, 1972, p. 295)

*Tuberitina bulbacea* Galloway & Harlton, 1928

## Algae

indet. algae

*Osagia* sp.

## Other skeletal fragments

bryozoan

## Sample 187

5 m above the violet shale, section height c. 17 m.

## Larger and smaller foraminiferids

*Pseudofusulinella* sp.

*Globivalvulina* sp.

*Climacammina* sp.

*Syzrania* sp.

? endothyrid

*Apterrinella* ? sp.

*Tuberitina* sp. or *Palaeocancellus* sp.

## Other skeletal fragments

bryozoan

ostracode

## Sample 179

17m above the violet shale, section height c. 29 m.

## Larger and smaller foraminiferids

*Triticites* sp.

cf. *Ozawainella* sp.

cf. *Schubertella* sp. (primitive form)

? *Pseudofusulinella* sp.

*Bradyina* sp.

*Globivalvulina* sp.

*Tetrataxis* group *T. conica* Ehrenberg, 1843

indet. tetrataxid

*Climacammina* group *C. moelleri* Reitinger,  
1950

*Cornuspira* sp.

*Glomospira* sp.

*Syzrania* sp.

*Monotaximoides* sp.

*Apterrinella* ? sp.

*Tuberitina* sp.

## Algae

indet. algae

*Osagia* sp.

## Other skeletal fragments

echinoderm

bryozoan

ostracode

coral

## Sample 183

19 m above the violet shale, section height c. 31 m.

Larger and smaller foraminiferids	Other skeletal fragments
<i>Triticites</i> sp. B ?	bryozoan
<i>Syzrania</i> sp.	gastropod
<i>Apterrinella</i> ? sp.	ostracode
<i>Eotuberitina</i> sp. (?foraminiferid)	? trilobite spine

## Sample 180

20.5 m above the violet shale, section height c. 32.5 m.

Larger and smaller foraminiferids	Other skeletal fragments
crushed schwagerinids (large proloculus)	brachiopod
<i>Tuberitina</i> sp. (?foraminiferid)	ostracode
	echinoderm

## Sample 181

22 m above the violet shale, section height c. 34 m.

Larger and smaller foraminiferids	Algae
<i>Triticites</i> sp. B ? (large proloculus, thick spirotheca)	indet. dasyclad alga
cf. <i>Ozawainella</i> sp.	Other skeletal fragments
? <i>Globivalvulina</i> sp.	fenestellid bryozoan
<i>Syzrania</i> sp.	bryozoan
<i>Apterrinella</i> ? sp.	gastropod
<i>Tuberitina</i> sp. (?foraminiferid)	sponge spicules

## Sample 178

Loose lying, upper part of the sequence.

Larger and smaller foraminiferids	<i>Syzrania</i> sp.
<i>Triticites</i> sp. D ?	<i>Tuberitina bulbacea</i> Galloway & Harlton, 1928
<i>Climacammina</i> sp.	(?foraminiferid)
<i>Apterrinella</i> ? sp.	
<i>Glomospira</i> sp.	Algae
	<i>Osagia</i> sp.

### Discussion

About twenty taxa of larger and smaller foraminiferids and six taxa of algae are present in the thin sections prepared from the ten samples from Hellefiskefjord. Of the larger foraminiferids, the Schwagerininae, *Triticites* spp. predominate whereas the Fusulininae, *Pseudofusulinella* spp. and others, are less common. This alone is indicative of the zone of *Triticites* which is of Missourian–Virgilian (Upper Pennsylvanian) age in terms of the south-western North America standard, and Gzhel'ian–Orenburgian (Upper Carboniferous) in terms of the Ural and Perm sections of eastern Europe. The considerable degree of septal folding and conspicuous chomata in the Hellefiskefjord *Triticites* is believed to be an evolutionary phase common to Upper Pennsylvanian members of the American *Triticites* group (Dunbar, 1963, p. 33, 37). Furthermore, the presence of *Pseudofusulinella* and *Schuchertella* suggests a Late Pennsylvanian, possibly Late Virgilian age (Dunbar, 1963, p. 42; Ross, 1967, p. 1345).

The fusulinid assemblage from Hellefiskefjord is younger than that reported by Thomson (1961), from Ward Hunt Island, off the northern tip of Ellesmere Island in the Canadian Arctic, which was assigned a Middle Pennsylvanian (Middle Desmoinesian) age. It is older than the Lower Permian (Artinskian) assemblage from the Belcher Channel Formation of Grinnell Peninsula, Devon Island (about 800 km south-west of Ward Hunt Island) described by Thorsteinsson (1960).

The assemblage of larger and smaller foraminiferids and algae is rather similar to that of the Virgilian Leavenworth Limestone of the Midcontinent region of the United States detailed by Toomey (1969, 1972) but it apparently lacks some of the endothyrids and algae.

All the Fusulinidae are cosmopolitan and are equated with the Midcontinent–Andean Realm, except for *Pseudofusulinella* which is apparently of the Eurasian–Arctic Realm (Ross, 1967).

Sedimentologically, several carbonate microfacies are discernible; angular quartz silt is locally abundant. Much of the fauna contains agglutinated, attached multilocular, and encrusting tubular smaller foraminiferids, associated with a diverse algal assemblage. These elements and the fact that the skeletal and floral fragments appear to be considerably diminished, suggest shallow marine shelf sedimentation.

In conclusion, the fusulinid-bearing lower unit of Troelsen's section in Hellefiskefjord may, in part, be coeval with the Belcher Channel Formation around Canon and Greely Fiords, Eureka Upland, central-western Ellesmere Island (Thorsteinsson, in Thorsteinsson & Tozer, 1970).

### Acknowledgements

Stratigraphical information on the Hellefiskefjord section was taken from J. C. Troelsen's unpublished diaries, P. R. Dawes supplied data on the geological and stratigraphical framework and J. S. Peel suggested several modifications to the text.

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## A reconnaissance of Quaternary deposits in northern Greenland

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The main aim of the 1976 field work was an investigation of the extent of Quaternary deposits in the central part of Olrik Fjord, north of Thule Air Base, North-West Greenland. In addition, other localities were visited across northern Greenland to locate and collect samples for  $C^{14}$  dating in order to supplement the hitherto sparse evidence of Holocene deglaciation and uplift of this region, i.e. at Narssârssuk, south of Thule Air Base, central Hall Land, J. P. Koch Fjord, and the delta of Børglum Elv in Peary Land (fig. 8).

### *Olrik Fjord*

Olrik Fjord is 80 km long. At its western junction with Hvalsund (Ikerssuaq) it is 8 km wide whereas its greatest part forms a 3–4 km wide channel penetrating plateau landscapes with surfaces at 800–1000 m above sea level. There are few earlier investigations of the Quater-